Space Weather Technical Forecast

Issued on Sunday, 30 June 2024 at 01:17 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of M-class flares throughout. Chance of G1/Minor Storm intervals Day 1 (30 Jun).

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Low with multiple low-level C-flares, peaking with a C5.9 at 29/1538 UTC. There are currently sixteen regions on the disc, most of which are small and simple. The largest regions are AR3719 in the southwest quadrant and AR3729 in the eastern central part. A newly numbered region, AR3734, has continued to rotate over the eastern limb, and was responsible for the largest flare of the period mentioned above. It appears to be a large and perhaps complex region, and will continue to be monitored and analysed as it rotates further into view.

A large filament in the southwest was observed lifting off from the Suns surface around 29/1530 UTC, with a subsequent CME observed in coronagraph imagery. An initial assessment suggests this could give Earth a glancing blow early on Day 4 (03 Jul), but further imagery is awaited for a complete analysis.

Solar Wind / Geomagnetic Activity: Solar winds observed by ACE and DSCOVR at L1 have declined since the arrival of a CME on 28 Jun. Solar winds were initially around 450 km/s, peaking briefly at 510 km/s, and have since settled around the 400-430 km/s mark. Density has declined from above average levels, peaking at 19 ppcc, down to below average levels. The Interplanetary Magnetic Field (IMF), Bt, has remained fairly steady, generally lying around 8-11 nT. The north-south component, Bz, has varied throughout the period, with periods of both positive (northward)) and negative (southward) orientation between +11 and -8 nT. Phi angle has been predominantly positive (away from the Sun) after being variable at the start of the period. Geomagnetic activity has been Quiet to Active (Kp2-4).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES18 remained at background levels. High energy electron flux (greater than 2MeV) observed by GOES16 was at background levels. The 24-hour fluence remained below Active, with 1.0e6 integrated pfu observed at 30/0000 UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Low activity is expected to continue with a chance of isolated M-flares.

Solar Wind / Geomagnetic Activity: Effects of the CME arrival on 28 Jun have continued to wane. There remains the possibility for further glancing CME arrivals on Day 1 (30 Jun), however confidence is low with uncertainties in timing and positioning of these. A large filament liftoff and subsequent CME were observed in imagery from around 29/1530 UTC. An initial assessment of this CME suggests a glancing blow early on Day 4 (03 Jul), with the bulk of the ejecta expected to pass below Earths orbit. Further imagery is awaited for a more thorough analysis to take place.

Geomagnetic activity is expected to be generally Quiet to Unsettled (Kp1-3), with a chance of

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Active to G1/Minor storm intervals (Kp4-5) on Day 1 (30 Jun) should the expected glancing blow materialise and combine its effect with the current slightly elevated solar wind background, however confidence remains low. Conditions are then expected to become largely Quiet from Day 2 (01 Jul) onwards, with perhaps another enhancement into Day 4 (03 Jul) with another CME glance.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at background levels. However, there is a very slight chance of exceeding the S1/Minor Storm threshold should any notable flares occur. High energy electron flux might show an increasing trend in the next few days after the recent CME influence. The associated 24-hour fluence is likely to remain below the Active threshold however, with a slight chance of exceeding later in the period.

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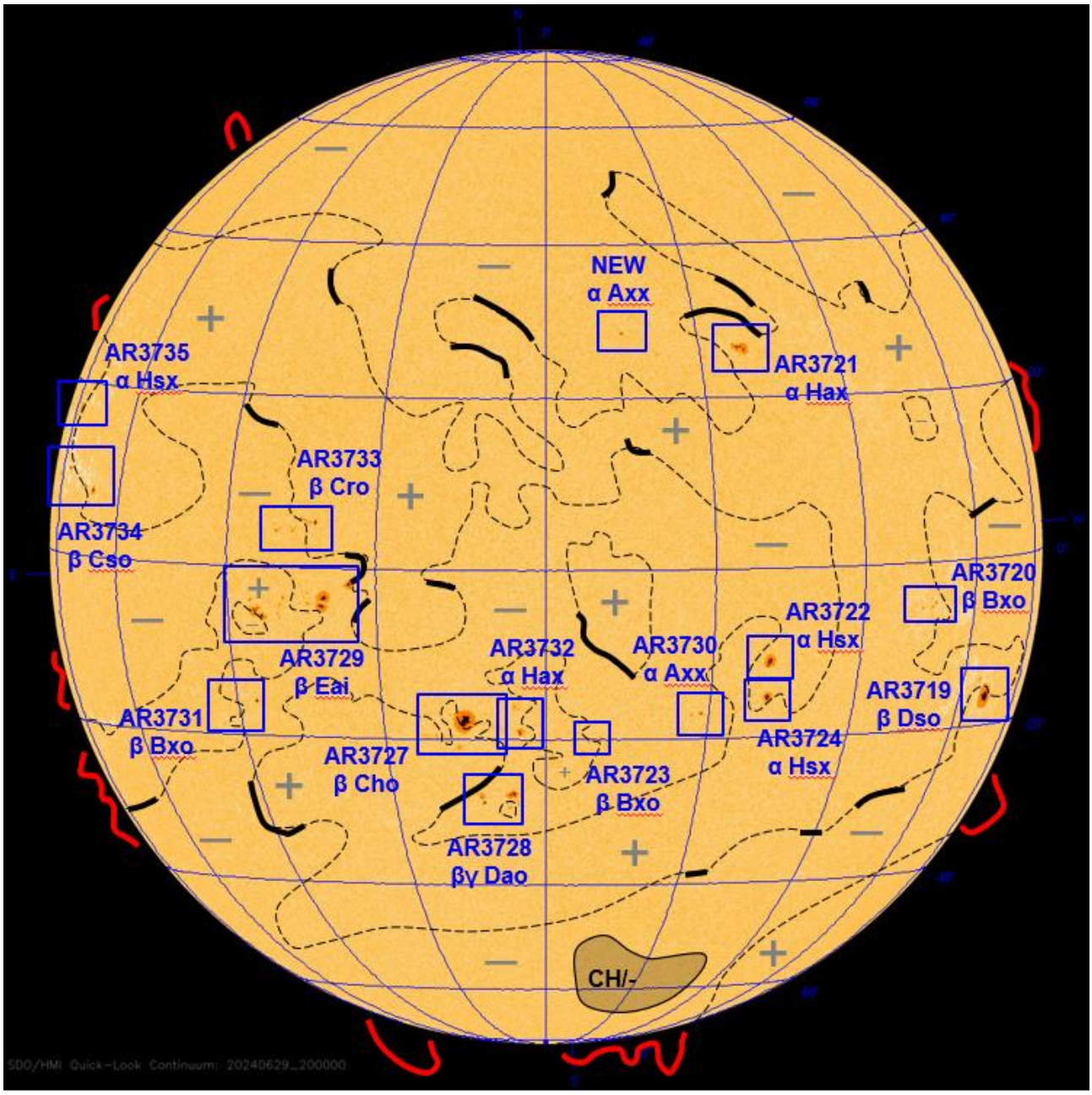
Figure 1. Solar Analysis Valid 29/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

The magnetic cloud associated with the CME that arrived at Earth on 28/0910 UTC has continued to wane. However, two further and potentially Earth-directed CMEs left the sun, respectively on 25 and 27 June. They could both give Earth a weak glancing blow on Day 1 (30 Jun) but confidence is low, with large uncertainties in timing and positioning. A large filament liftoff was observed around 29/1530 UTC in the southwest, with a resulting large CME observed leaving the Sun in coronagraph imagery. An initial analysis suggests a glancing blow early on Day 4 (03 Jul) with the bulk of the ejecta passing below Earths orbit. This is just an initial fit however, with further analysis awaiting more imagery to come in.

There are no significant coronal holes on the disc to give any fast wind influence.

Geomagnetic activity is expected to be generally Quiet to Unsettled (Kp1-3), with a chance of Active to G1/Minor storm intervals (Kp4-5) on Day 1 (30 Jun) should the expected glancing blow materialise and combine its effect with the current slightly elevated solar wind background, however confidence remains low. Conditions are then expected to become largely Quiet from Day 2 (01 Jul) onwards, with perhaps another enhancement into Day 4 (03 Jul) with another CME glance.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	5	5	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
26/0701	Partial	AR3720 + filament	S-Centre	400 km/s	29/1200 UTC +/- 12 hrs	Likely missed going off expected arrival time. Only weak impacts likely.
28/0200	Partial	AR3719	SW	390 km/s	30/0600 UTC +/- 9 hrs	Glancing blow possible.
29/2021	Partial	Filament	SW	869 km/s	03/0000 UTC +/- 12 hrs	Glancing blow possible. Limited analysis only.

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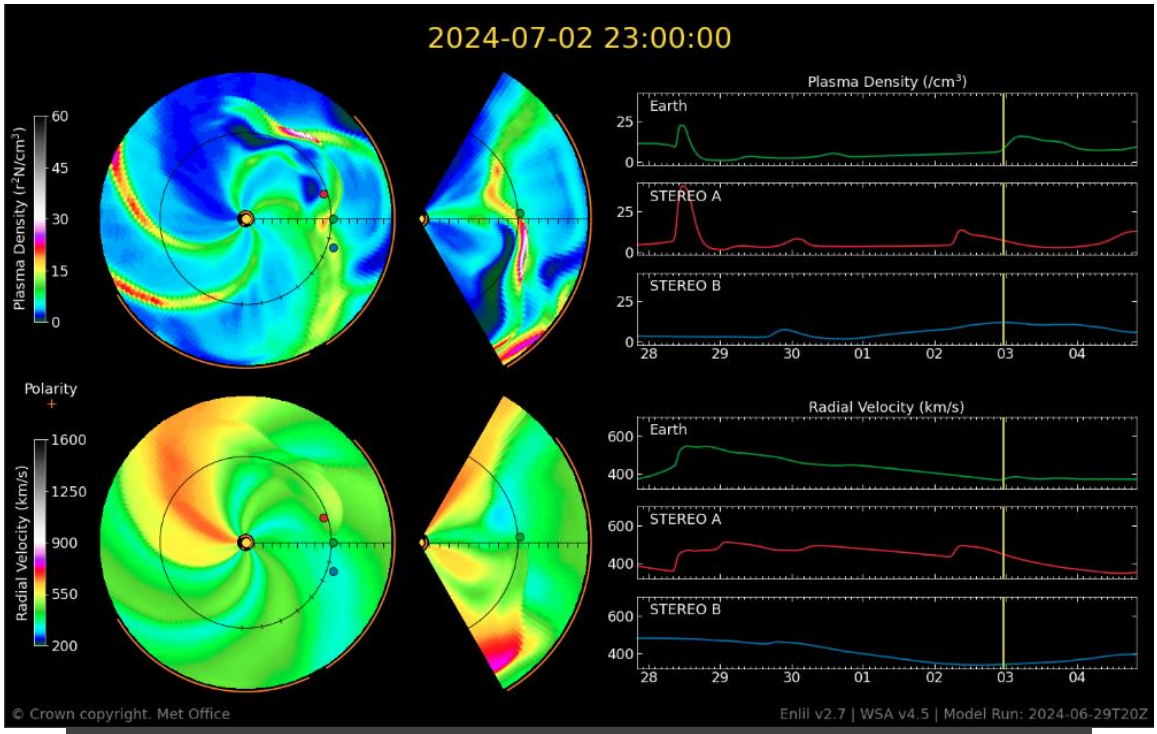
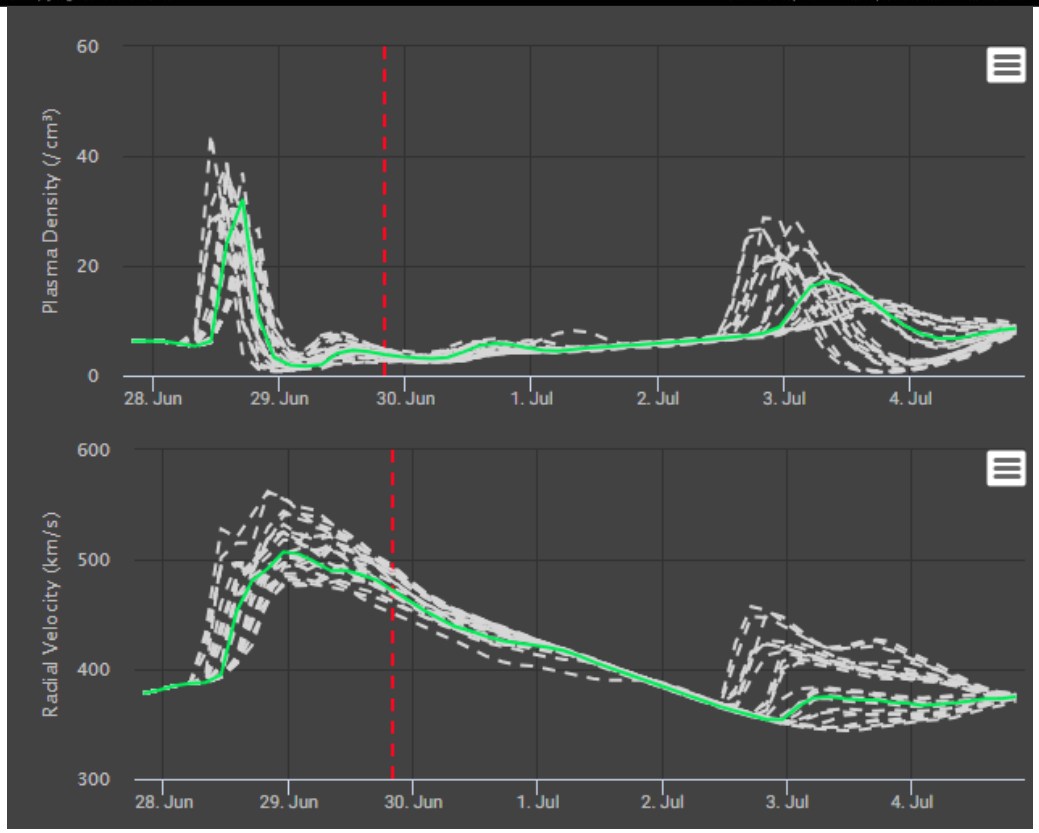
Figure 2: MOSWOC Enlil and Ensemble models





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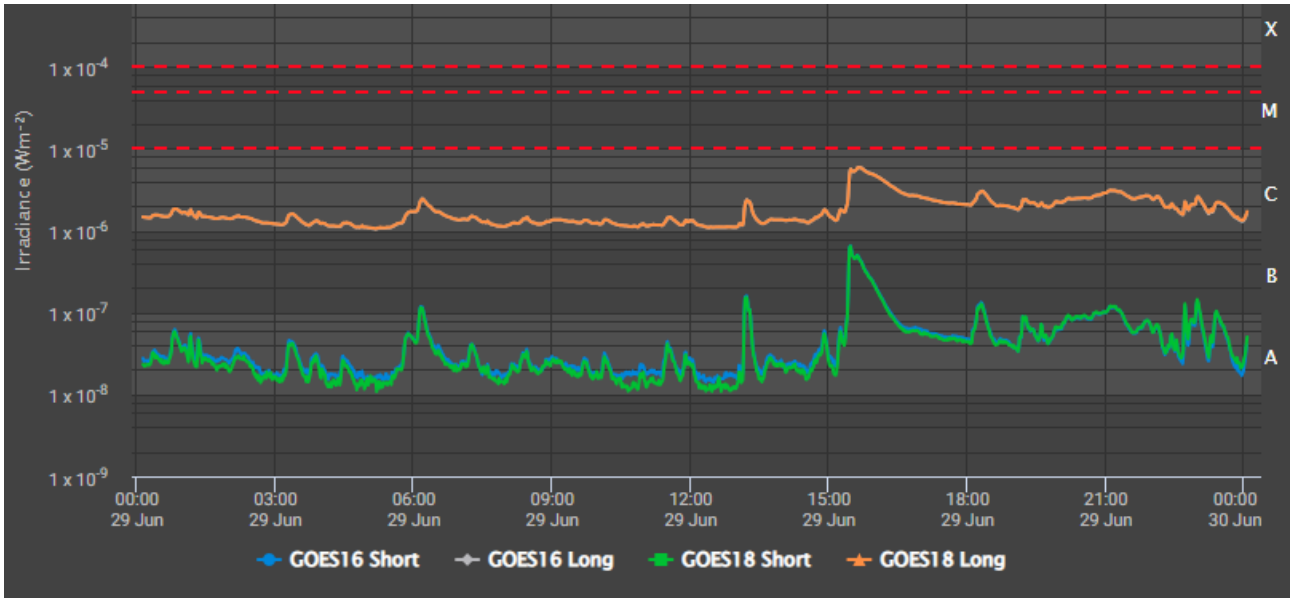
Radio Blackouts - X-Ray Flares:
There are currently sixteen regions on the disc, most of which are small and simple. The largest regions are AR3719 in the southwest quadrant and AR3729 in the eastern central part. AR3719 now seems to be a large mature spot, with any smaller spots generally fading. AR3729 continues to see a proliferation of intermediate spots, with its trailing part somewhat fragmented, and overall growth stalling. AR3733 to the north of this has continued to show growth, however it is currently relatively simple (Beta/Cro) but worth monitoring. Two recently numbered regions continue rotating around the eastern limb; the more southern of these, AR3734, appears to be a larger and perhaps complex region, and has been the most active this past 24 hours (C5.9 peaking at 29/1538 UTC the largest flare of the period). Analysis of this region remains difficult due to foreshortening effects, and it will continue to be monitored as it rotates further into view.

A chance of isolated M-class flares is maintained throughout the period, with a very slight chance of isolated X-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: GOES-16 & -18 X-ray flux



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Solar Radiation Storms - (High Energy Protons):
High energy proton flux, as measured by GOES-18, is most likely to remain at background levels. Despite a large amount of sunspots on the Earth-facing disc, they are relatively small and magnetically simple or not showing any tangible sign of imminent flare which could potentially enhance the proton flux.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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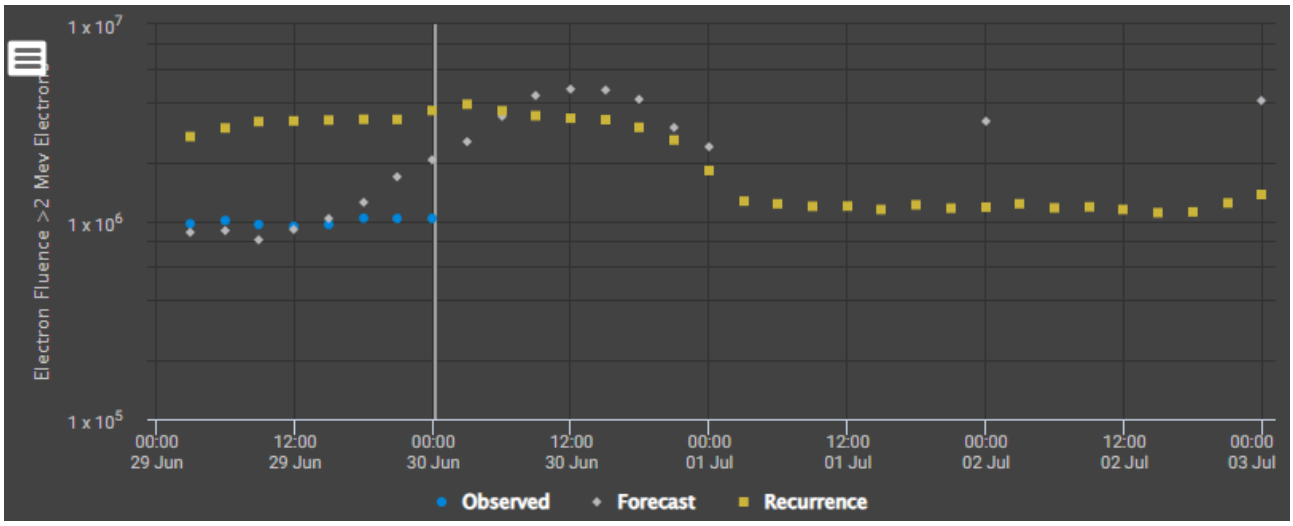
High Energy Electrons Event (≥ 2MeV):
High energy electron flux, as observed by GOES-16, is expected to continue at background levels for the start of the period. The recent CME enhancement may have caused an increase in electron flux below GEO, but the potential for further CME arrivals could suppress this once again. Overall, electron flux is most likely to stay at background levels, but as the solar wind speeds decline there is the possibility of an increase to peak at moderate or perhaps high levels later in the period.

Associated electron fluence is most likely to persist below the Active threshold (1e8 integrated pfu), but with a slight chance of an increase above Active later in the period. MOSWOC REFM is forecasting below Active through the next three days, which is the most probable outcome.

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}\,sr^{-1}\,day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	10	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: MOSWOC REFM



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